



U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of Airport Safety and Standards
Engineering and Specifications Division

800 Independence Ave., SW
Washington, DC 20591

August 24, 1999

The attached is draft Change 14 to Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5370-10A Standards for Specifying Construction of Airports. Part XI, Lighting Installations, L-Series specifications have been updated. The primary changes are as follows:

1. Advisory Circular AC 150/5345-1, Approved Airport Equipment, is replaced by AC 150/5345-53, Airport Lighting Equipment Certification Program.
2. Red lead priming paint has been replaced with Fed. Spec. TT-P-664D.
3. Fed. Spec. TT-P-641 has been replaced with MIL-P-24441/19B.
4. Fed. Spec TT-P-59 has been replaced with Fed. Spec. TT-E-489.
5. Fed. Spec TT-P-102 has been replaced with Commercial Item Description A-A-3067.
6. Paragraph 103-2.7a. Fed. Spec. TT-P-641 has been replaced with MIL-P-24441/19B.
7. REA Bulletin 345-14 has been replaced by ICEA-S-85-625-1996.
8. The acceptable method for cast splicing is no longer restricted to the Scotchcast Kit No. 82 B or Hyseal Epoxy Splice Kit No. E1135. Any method of equal worth is now acceptable.
9. Paragraph 108-2.4b. This item has been rephrased from "...A vulcanized splice employing Joy Manufacturing Company's Vulcanizing Kit No. x- 1604-8 or equal is approved for field vulcanization splices. The proper molds for various cable sizes shall be used..." to "...A vulcanized splice with proper molds for various cable sizes shall be used..."
10. Mil. Spec. MIL-I-3825 has been replaced with ASTM D 4388.
11. Mil. Spec. MIL-I-24391 or Commercial Item Description A-A-55809 has been replaced by Mil Spec. MIL-I-24391 or Commercial Item Description A-A-55809.
12. Fed. Spec. SS-A 694 has been replaced with ASTM D 2823.
13. ANSI 8.35 has been replaced by ANSI/ICEA S-70-547-1992.

Comments are accepted through recognized industry organizations. The comment period closes October 12, 1999.

PART XI--LIGHTING INSTALLATION

ITEM L-101 INSTALLATION OF AIRPORT ROTATING BEACONS

DESCRIPTION

101-1.1 This item shall consist of furnishing and installing airport rotating beacons. This work shall include the mounting, leveling, wiring, painting, servicing, and testing of the beacon and all materials and incidentals necessary to place the beacons in operating condition as a completed unit to the satisfaction of the Engineer. This item shall include a mounting platform if specified in the plans.

EQUIPMENT AND MATERIALS

101-2.1 GENERAL.

a. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall be certified and listed under Advisory Circular (AC) 150/5345-53, Airport Lighting Equipment Certification Program.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the Engineer.

101-2.2 BEACON. The beacon shall meet the requirements of AC 150/5345-12, Specification for Airport and Heliport Beacons.

101-2.3 PANEL BOARDS AND BREAKERS. Panel boards and breakers shall conform to the requirements of Fed. Spec. W-P-115.

101-2.4 WEATHERPROOF CABINETS. The weatherproof cabinets shall conform to National Electrical Manufacturers Association Standards and shall be constructed of steel not less than No. 16 USS gauge.

101-2.5 WIRE. Wire in conduit rated up to 5,000 volts shall conform to AC 150/5345-7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits for Rubber Insulated Neoprene Covered Wire, or Fed. Spec. J-C-30, Type RHW, for rubber insulated fibrous covered wire. For ratings up to 600 volts, the thermoplastic wire conforming to Fed. Spec. J-C-30, Types TW, THW, and THWN, shall be used. The wires shall be of the type, size, number of conductors, and voltage shown in the plans or in the proposal.

101-2.6 CONDUIT. Rigid steel conduit and fittings shall conform to the requirements of Underwriters Laboratories Standard 6, 514, and 1242.

101-2.7 PAINT.

a. Priming paint for ungalvanized metal surfaces shall be a high solids alkyd primer conforming to TT-P-664D.

b. Priming paint for galvanized metal surfaces shall be zinc dust-zinc oxide primer paint conforming to MIL-P-24441/19B. If necessary, add not more than ½ pint (0.06 liter) of turpentine to each gallon (liter).

c. Orange paint for the body and the finish coats on metal and wood surfaces shall consist of a ready-mixed non-fading paint meeting the requirements of Fed. Spec. TT-E-489. The color shall be in accordance with Federal Standard 595, Aviation Gloss Orange Number 12197.

d. White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to Commercial Item Description A-A-3067.

e. Priming paint for wood surfaces shall be mixed on the job by thinning the above-specified orange or white paint with ½ pint (0.06 mm) of raw linseed oil to each gallon (liter).

CONSTRUCTION METHODS

101-3.1. PLACING THE BEACON. The beacon shall be mounted on a beacon tower, platform, or building roof as shown in the plans.

101-3.2 HOISTING AND MOUNTING. The beacon shall be hoisted to the mounting platform by using suitable slings and hoisting tackle. Before fastening the beacon to the mounting platform, the mounting holes shall be checked for correct spacing. Beacon base or mounting legs shall not be strained or forced out of position to fit incorrect spacing of mounting holes. The beacon base shall be raised first, set in position, and bolted in place. The drum shall then be raised and assembled to the base.

101-3.3 LEVELING. After the beacon has been mounted in place, it shall be accurately leveled. The leveling shall be checked in the presence of the Engineer and shall be to the Engineer's satisfaction.

101-3.4 SERVICING. Before placing the beacon in operation, the Contractor shall accomplish the following:

a. Clean and polish all glassware, both inside and outside, using a type of cleaner which will not scratch the lens, and clean the interior of the beacon.

b. Clean interior of beacon base and check for alignment of parts.

c. Clean and polish slip rings. Apply a very small amount of petroleum jelly to the slip rings, operate about ½ hour, then wipe the surplus off the rings. Remove the brushes and lubricate the chamber of brush holders.

d. Grease gears of rotating mechanism where gears are accessible. Check to see if gears mesh properly, and turn the motor shaft by hand to ascertain if action of gear train is free. Check and adjust the clutch tension. The clutch should be not quite tight enough to stall the motor when the lamp-rotating element is held fast fill grease fittings with grease conforming to the manufacturer's or Engineer's recommendations.

e. Set brushes for free motion on slip rings, and adjust springs to 1 or 2 pounds (454 to 908 grams) pressure to provide firm contact.

f. Secure lamps properly in the sockets.

101-3.5 BEAM ADJUSTMENT. After the beacon has been mounted and leveled, the elevation of the beams shall be adjusted. The final beam adjustments shall be made at night so that results can be readily observed. The beams shall be adjusted to the elevation directed by the Engineer or as shown in the plans, except that, in no case shall the elevation of the beams be less than 2 degrees above the horizontal.

101-3.6 BEACON MOUNTING PLATFORM. Where the beacon is to be mounted at a location other than the beacon tower and where a special mounting platform is required, the construction of this mounting platform and any necessary lightning protection equipment shall be in accordance with the details shown in the plans.

101-3.7 WIRING. The Contractor shall furnish all necessary labor and materials and shall make complete above ground electrical connections in accordance with the wiring diagram furnished with the project plans.

If underground cable for the power feed from the transformer vault to the beacon site and duct for this cable installation under paved areas is required, the cable and duct shall be installed in accordance with and paid for by linear foot measurement as described in Item L-108, Installation of Underground Cable for Airports, and Item L-110, Installation of Airport Underground Electrical Duct.

Unless otherwise specified, the Contractor shall connect the tell-tale relay mechanism in the beacon to energize the tower obstruction light circuit when failure of the beacon service (primary) lamp occurs.

If lightning protection is specified in the plans or proposal as a part of this item, it shall be in accordance with 103-2.3, 103-2.4, 103-2.5, 103-2.6, and 103-3.4 in Item L-103, Installation of Airport Beacon Towers.

101-3.8 PANEL AND CABINET. Unless otherwise specified, the Contractor shall furnish and install at the top of the beacon tower or mounting platform a circuit-breaker panel consisting of four 15-ampere breakers mounted in a weather-proof cabinet to provide separate protection for the circuits to the beacon lamps, motor, obstruction lights, and other equipment. The cabinet shall be located on the side of the beacon platform, as directed by the Engineer.

101-3.9 CONDUIT. All exposed wiring shall be run in not less than ½ inch galvanized rigid steel conduit. No conduit shall be installed on top of a beacon platform floor. All conduit shall be installed to provide for drainage. If mounted on a steel beacon tower, the conduit shall be fastened to the tower members with “wraplock” straps, clamps, or approved fasteners, spaced approximately 5 feet (150 cm) apart. The conduit shall be fastened to wooden structures with galvanized pipe straps and with galvanized wood screws not less than No. 8 nor less than 1-¼ inches (31 mm) long. There shall be at least two fastenings for each 10-foot (3 m) length.

101-3.10 BOOSTER TRANSFORMER. If shown in the plans or specified in job specifications, a booster transformer to compensate for voltage drop to the beacon shall be installed in a suitable weatherproof housing under or on the tower platform or at the base of the tower. The installation shall be as indicated in the plans and described in the proposal. If the booster transformer is required for installation in the transformer vault, it shall be installed in accordance with and paid for as described in Item L-109, Installation of Airport Transformer Vault and Vault Equipment.

101-3.11 PHOTOELECTRIC CONTROL. If shown in the plans or specified in job specifications, the Contractor shall furnish and install an automatic control switch at the location indicated in the plans. The switch shall be a photoelectric type. It shall be a standard commercially available unit suitable for aviation service. It shall be installed, connected, and adjusted in accordance with the manufacturer's instructions.

101-3.12 OBSTRUCTION LIGHTS. Unless otherwise specified, the Contractor shall install on the top of the beacon tower or mounting platform two L-810 obstruction lights on opposite corners. These lights shall be mounted on conduit extensions to a height of not less than 4 inches (100 mm) above the top of the beacon. They shall be connected in series into the tell-tale circuit with the necessary relay and wiring connections.

101-3.13 PAINTING. If construction of a wooden mounting platform is stipulated in the proposal as part of this item, all wooden parts of the platform shall be given one priming coat of white or aviation-orange paint after fabrication but before erection and one body and one finish coat of aviation-orange paint after erection. Steel mounting platforms shall be given one priming coat of corrosion-inhibiting primer before erection and one body and one finish coat of aviation-orange paint after erection. All equipment installed under this contract and exposed to the weather shall be given one body and one finish coat of aviation-orange or white paint as required. This shall include beacon (except glass surfaces), beacon base, breaker cabinet, all conduit, and transformer cases. It shall not include lightning rods or obstruction light globes.

The paint shall be applied uniformly in the proper consistency by skilled painters. The finished paint shall be free from sags, holidays, and smears. Each coat of paint shall be given ample time to dry and harden before the next coat of paint is applied. A minimum of 3 days shall be allowed for drying on wood surfaces, and a minimum of 4 days shall be allowed for drying on metal surfaces. Painting shall not be done in cold, damp, foggy, dusty, or frosty atmospheres, or when air temperature is below 40° F (4° C), nor started when the weather forecast indicates such conditions for the day.

All surfaces shall be cleaned before painting. The surfaces shall be dry and free from scale, grease, rust, dust, and dirt when paint is applied. All knots in wood surfaces shall be covered with shellac immediately before applying the priming coat of paint. Nail holes and permissible imperfections shall be filled with putty. The ready-mixed paint shall be thinned for the priming and body coats in accordance with the manufacturer's recommendations. In the absence of such recommendations, the following shall apply:

a. Body coats (for both wood and steel surfaces) - add ½ pint (0.06 liter) of turpentine to each gallon (liter) of ready-mixed paint for body coats.

b. Finish coats (for both wood and steel surfaces) the ready-mixed paint shall be used as it comes from the container for finish coats.

101-3.14 TESTING. The installation shall be fully tested in operation as a completed unit prior to acceptance. These tests shall include operation of the lamp-changer operation and taking megger and voltage readings. The insulation resistance to ground of the beacon supply circuit shall be not less than 50 megohms when measured ungrounded. Testing equipment shall be furnished by the Contractor. Tests shall be conducted in the presence of the Engineer and shall be to his/her satisfaction.

METHOD OF MEASUREMENT

101-4.1 The quantity to be paid for shall be the number of beacons installed as completed units in place, accepted, and ready for operation.

BASIS OF PAYMENT

101-5.1 Payment will be made at the contract unit price for each completed and accepted job. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-101-5.1	Airport Rotating Beacon, in place--per unit
----------------	---

MATERIAL REQUIREMENTS

AC 150/5345-7	Specification for L-824 Underground Cable for Airport Lighting Circuits
---------------	---

AC 150/5345-12	Specification for Airport and Heliport Beacons
----------------	--

Commercial Item Description A-A-3067	Paint: Alkyd, Exterior, Low VOC
--------------------------------------	---------------------------------

Fed. Spec. J-C-30	Cable and Wire, Electrical (Power, Fixed Installation)
-------------------	--

Fed. Spec. TT-E-489	Enamel, Alkyd, Gloss, Low VOC Content
---------------------	---------------------------------------

Fed. Spec. TT-P-664D	Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant
----------------------	--

Fed. Spec. W-P-115	Panel, Power Distribution
--------------------	---------------------------

Fed. Std. 595	Colors
---------------	--------

MIL-P-24441/19B	Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III
-----------------	--

Underwriters Laboratories Standard 6	Rigid Metal Conduit
--------------------------------------	---------------------

Underwriters Laboratories Standard 514	Fittings for Conduit and Outlet Boxes
--	---------------------------------------

Underwriters Laboratories Standard 1242	Intermediate Metal Conduit
---	----------------------------

ITEM L-102 INSTALLATION OF HAZARD BEACON

DESCRIPTION

102-1.1 This item shall consist of furnishing and installing a hazard flashing beacon in accordance with these specifications. This work shall include the mounting, leveling, wiring, servicing, painting, and testing of the beacon and all materials and incidentals necessary to place it in operating condition as a completed unit to the satisfaction of the Engineer. This item shall include a mounting platform if specified in the plans.

EQUIPMENT AND MATERIALS

102-2.1 GENERAL.

a. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall be certified and listed under Advisory Circular (AC) 150/5345-53, Airport Lighting Equipment Certification Program.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when requested by the Engineer.

102-2. BEACON. The beacon shall conform to the requirements of AC 150/5345-43, Specification for Obstruction Lighting Equipment.

102-2.3 PANEL BOARDS AND BREAKERS. Panel boards and breakers shall conform to the requirements of Fed. Spec. W-P-115.

102-2.4 WEATHERPROOF CABINETS. Weatherproof cabinets shall conform to National Electrical Manufacturers Association Standards and shall be constructed of steel not less than No. 16 USS gauge.

102-2.5 WIRE. Wire in conduit rated up to 5,000 volts shall conform to AC 150/5345-7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits for Rubber Insulated Neoprene Covered Wire, or Fed. Spec. J-C 30, Type RHW, for rubber insulated fibrous covered wire. For ratings up to 600 volts, thermoplastic wire conforming to Fed. Spec. J-C-30, Types TW, THW, and THWN shall be used. The wires shall be of the type, size, number of conductors, and voltage shown in the plans or in the proposal.

102-2.6 CONDUIT. Rigid steel conduit and fittings shall conform to the requirements of Underwriters Laboratories Standard 6, 514, and 1242.

102-2.7 PAINT

a. Priming paint for ungalvanized metal surfaces shall be a high solids alkyd primer conforming to TT-P-664D.

b. Priming paint for galvanized metal surfaces shall be zinc dust-zinc oxide primer paint, conforming to MIL P 24441/19B. If necessary, add not more than ½ pint (0.06 liters) of turpentine to each gallon (liter).

c. Orange paint for the body and the finish coats on metal and wood surfaces shall consist of a ready-mixed non-fading paint meeting the requirements of Fed. Spec. TT-E-489. The color shall be in accordance with Federal Standards 595, Aviation Gloss Orange Number 12197.

d. White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to Commercial Item Description A-A-3067.

e. Priming paint for wood surfaces shall be mixed on the job by thinning the above specified orange or white paint by adding ½ pint (0.06 liters) of raw linseed oil to each gallon (liter).

102-2.8 FLASHER. The beacon flasher shall be a standard commercially available unit designed for the service intended. The mechanism in the flasher shall be designed to flash not more than 40 and not less than 12 flashes per minute. The flashing switch shall be of the mercury contact-type encapsulated in nonbreakable plastic. The entire unit shall be housed in a weatherproof cabinet.

CONSTRUCTION METHODS

102-3.1 PLACING THE BEACON. The beacon shall be mounted on a beacon tower, platform, building roof, or on a pole as shown in the plans.

102-3.2 MOUNTING AND LEVELING. The support to which the beacon is fastened shall be accurately leveled before mounting the beacon.

102-3.3 FLASHER. If shown in plans or specified in job specifications, a separate flashing mechanism for the beacon shall be installed adjacent or near the beacon. The mechanism in this flasher shall be designed to flash not more than 40 and not less than 12 flashes per minute.

102-3.4 MOUNTING PLATFORM. If shown in plans or specified in job specifications, the Contractor shall construct a special mounting platform for the beacon, flasher, and incidental equipment. Design and materials for the special platform shall be as shown in the plans. This mounting platform may be constructed on top of a steel beacon tower, or wood pole if specified, and shall be as shown in the plans.

102-3.5 WIRING. The Contractor shall furnish all necessary labor and materials and shall make complete aboveground electrical connections in accordance with the wiring diagram furnished with the project plans.

If underground cable for the power feed from the transformer vault to the beacon site and duct for the installation of this cable under paved areas is required, the cable and duct shall be installed in accordance with and paid for by linear foot measurement as described in Item L-108, Installation of Underground Cable for Airports, and Item L-110, Installation of Airport Underground Electrical Duct.

If lightning protection is specified in the plans or proposals as a part of this item, it shall be in accordance with Item L-103, Installation of Airport Beacon Towers, paragraphs 103-2.3, 103-2.4, 103-2.5, 103-2.6, and 103-3.4.

102-3.6 PANEL AND CABINET. If shown in plans or specified in job specifications, the Contractor shall furnish and install a circuit breaker panel. The panel shall be of the type and rating indicated in the plans, and it shall be mounted in a weatherproof cabinet. The cabinet shall be located near the beacon or as directed by the Engineer.

102-3.7 CONDUIT. All exposed wiring shall be run in not less than ½ inch (12 mm) galvanized rigid steel conduit. No conduit shall be installed on top of a beacon platform floor. All conduit shall be installed to provide for drainage. If mounted on a steel beacon tower, the conduit shall be fastened to the tower members with “wraplock” straps, clamps, or approved fasteners spaced approximately 5 feet (150 cm) apart. Conduit shall be attached to wooden structures with galvanized pipe straps and fastened with galvanized wood screws not less than No. 8 nor less than 1-¼ inches (31 mm) long. There shall be at least two fastenings for each 10-foot (3 m) length.

102-3.8 BOOSTER TRANSFORMERS. If shown in plans or specified in job specifications, a booster transformer to compensate for voltage drop to the beacon shall be installed in a suitable weatherproof housing under or on the tower platform or at the base of the tower or pole. The installation shall be as indicated in the plans and described in the proposal. If the booster transformer is required for installation in the transformer vault, it shall be installed in accordance with and paid for as described in Item L-109, Installation of Airport Transformer Vault and Vault Equipment.

102-3.9 PHOTOELECTRIC CONTROL. If shown in plans or specified in job specifications, the Contractor shall furnish and install an automatic control switch at the location indicated in the plans. This switch shall be a

photoelectric type. It shall be a standard commercially available unit suitable for aviation service. It shall be installed, connected, and adjusted in accordance with the manufacturer's instruction.

102-3.10 PAINTING. Wood poles and wooden parts of mounting platforms shall be given one priming coat of white or aviation-orange paint after fabrication but before erection and one body and one finish coat of aviation-orange paint after erection. Steel mounting platforms shall be given one priming coat of corrosion-inhibiting primer before erection and one body and one finish coat of aviation-orange paint after erection. All equipment under this contract and exposed to the weather shall be given one body and one finish coat of aviation-orange or white paint as required. This shall include beacon (except glass surfaces), breaker cabinet, and all conduit and transformer cases. It shall not include lightning rods.

The paint shall be applied uniformly in the proper consistency by skilled painters. The finished paint shall be free from sags, holidays, and smears. Each coat of paint shall be given ample time to dry and harden before the next coat of paint is applied. A minimum of 3 days shall be allowed for drying on wood surfaces and a minimum of 4 days shall be allowed for drying on metal surfaces. Painting shall not be done in cold, damp, foggy, dusty, or frosty atmospheres, or when air temperature is below 40° F (4° C), nor started when the weather forecast indicates such conditions for the day.

All surfaces shall be cleaned before painting. The surfaces shall be dry and free from scale, grease, rust, dust, and dirt when paint is applied. All knots in wood surfaces shall be covered with shellac immediately before applying the priming coat of paint. Nail holes and permissible imperfections shall be filled with putty.

The ready-mixed paint shall be thinned for the priming and body coats in accordance with the manufacturer's recommendations. In the absence of such recommendations, the following shall apply:

a. Body coats (for both wood and steel surfaces) - add ½ pint (0.06 liters) of turpentine to each gallon (liter) of ready-mixed paint for body coats.

b. Finish coats (for both wood and steel surfaces) - the ready-mixed paint shall be used as it comes from the container for finish coats.

102-3.11 TESTING. The installation shall be tested in operation as a completed unit prior to acceptance. Tests shall include taking megger and voltage readings. Testing equipment shall be furnished by the Contractor. The insulation resistance to ground of the beacon supply circuit shall be not less than 50 megohms when measured ungrounded.

Tests shall be conducted in the presence of the Engineer and shall be to his/her satisfaction.

METHOD OF MEASUREMENT

102-4.1 The quantity to be paid for shall be the number of beacons installed as completed units in place, accepted, and ready for operation.

BASIS OF PAYMENT

102-5.1 Payment will be made at the contract unit price for each completed and accepted job. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-102-5.1	Hazard Beacon, in place--per unit
----------------	-----------------------------------

MATERIAL REQUIREMENTS

AC 150/5345-7	Specification For L-824 for Underground Electrical Cable for Airport Lighting Circuits
---------------	--

AC 150/5345-43	Specification for Obstruction Lighting Equipment
----------------	--

Commercial Item Description A-A-3067	Paint: Alkyd, Exterior, Low VOC
---	---------------------------------

Fed. Spec. J-C-30	Cable and Wire, Electrical (Power, Fixed Installation)
-------------------	--

Fed. Spec. TT-E-489	Enamel, Alkyd, Gloss, Low VOC Content
---------------------	---------------------------------------

Fed. Spec. TT-P-664D	Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant
----------------------	--

MIL-P-24441/19B	Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III
-----------------	--

Fed. Spec. W-P-115	Panel, Power Distribution
--------------------	---------------------------

Fed. Std. 595	Colors
---------------	--------

Underwriters Laboratories Standard 6	Rigid Metal Conduit
--	---------------------

Underwriters Laboratories Standard 514	Fittings for Conduit and Outlet Boxes
--	---------------------------------------

Underwriters Laboratories Standard 1242	Intermediate Metal Conduit
---	----------------------------

ITEM L-103 INSTALLATION OF AIRPORT BEACON TOWERS

DESCRIPTION

103-1.1 This item shall consist of furnishing and installing an airport beacon tower of the type shown in the plans, in accordance with these specifications. This work shall include the clearing of the site, erection of the tower, installation of lightning protection, painting, and all incidentals necessary to place it in operating condition as a completed unit to the satisfaction of the Engineer.

EQUIPMENT AND MATERIALS

103-2.1 GENERAL. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the Engineer.

103-2.2 TOWER. The beacon tower shall conform to the requirements of Advisory Circular (AC) 150/5340-21, Airport Miscellaneous Lighting Visual Aids, Section 3.

103-2.3 LIGHTING ROD. The lightning rod shall consist of a galvanized steel, copper, or copper-clad rod with the upper end drawn to a point and of sufficient length to extend from the point of fastening to not less than 6 inches (150 mm) above the top of the beacon.

103-2.4 DOWN CONDUCTOR. The down conductor cable for lightning protection shall consist of No. 8 AWG or larger bare stranded copper wire.

103-2.5 GROUND ROD. The ground rod shall be of the diameter and length specified in the plans. It shall be copper or copper clad.

103-2.6 GROUND CLAMP. Ground clamp shall be similar and equal to the Type GR as manufactured by the Burndy Engineering Company.

103-2.7 PAINT.

a. Priming paint for galvanized steel towers shall be zinc dust-zinc oxide primer paint conforming to MIL-P-24441/19B. If necessary, add not more than 1/2 pint (0.06 liter) of turpentine to each gallon (liter).

b. Priming paint for ungalvanized steel towers shall be a high solids alkyd primer conforming to TT-P-664D.

c. Orange paint for the body and finished coats on metal and wood surfaces shall consist of a ready-mixed nonfading paint meeting the requirements of Fed. Spec. TT-E-489. The color shall be in accordance with Federal Standard 595, Aviation Gloss Orange Number 12197.

d. White paint for steel tower shall be ready-mixed paint conforming to Commercial Item Description A-A-3067.

CONSTRUCTION METHODS

103-3.1 CLEARING AND GRADING. The site on which the beacon tower is to be erected shall be cleared and leveled. All trees and brush shall be removed from the area within a distance of 25 feet (7.5 m) from the tower or as called for in the job plans. Stumps shall be removed to a depth of 18 inches (45 cm) below finished grade and the excavation filled with earth and tamped. If a transformer vault or other structure is included as part of the installation, the area shall be cleared to a distance of 25 feet (7.5 m) from these structures. The ground near the tower shall be leveled to permit the operation of mowing machines. The leveling shall extend at least 2 feet (60 cm) outside the tower legs. All debris removed from the tower site shall be disposed of by the Contractor to the satisfaction of the Engineer and in accordance with Federal, state, or local regulations.

103-3.2 EXCAVATION AND FILL. Excavation for the tower footings shall be carried to a minimum of 4 inches (100 mm) below the footing depth. The excess excavation below the footing depth shall then be backfilled with gravel or crushed stone and compacted to the required level. The footing plates shall be installed, and a thickness of not less than 18 inches (45 cm) of the same gravel or crushed stone shall be placed immediately above the footing plates in layers of not over 6 inches (150 mm). Each layer above the footing plates shall be thoroughly tamped in place. The remainder of the backfill may be of excavated earth placed in layers not to exceed 6 inches (150 mm). Each layer shall be thoroughly compacted by tamping.

Where solid rock is encountered, which prevents the carrying of the foundation legs to the required depth but which is of sufficient strength to use holddown bolts, the tower anchor posts shall be cut off at the required length and the holddown bolts shall be installed as indicated in the plans with the approval of the Engineer. Each tower leg shall be anchored to the rock by means of two 7/8-inch (21 mm) diameter by 3-foot (90 cm) long expansion or split bolts and shall be grouted with neat portland cement into holes drilled into the natural rock. Except as required for rock foundations, the footing members shall not be cut off or shortened. If excavated material is of such character that it will not readily compact when backfilled, the Engineer may order the excavation backfilled with concrete or other suitable material.

The concrete footing for tubular beacon towers shall be installed in accordance with the manufacturer's recommendations. Portions of the footing in the topsoil layer shall not be included in the footing height.

103-3.3 ERECTION. Detail erection drawings furnished by the manufacturer shall be strictly followed during construction. All towers shall be erected in sections from the ground up unless otherwise specified. In final assembly, all bolts and fastenings shall be installed, and the structure shall be plumb, true, square, and level. Nuts shall be taken up to a firm bearing after which the bolts shall, if necessary, be cut to proper length to protrude three full threads. Approved locknuts shall be placed on each bolt over the regular nut. Ladder bolts shall be inserted with the head to the outer face of the tower. Diagonal, leg, and handrail bolts shall be installed with nuts on the outer face of the tower, unless otherwise specified. Bent parts shall be straightened before erection without damage to the protective coating. Surfaces abraded or bared of protective coating shall be painted with the proper priming paint as specified in these specifications.

The Contractor shall install the ladder on the side of the tower adjacent to the driveway or most accessible approach to the tower. Tubular beacon towers shall be erected in accordance with the manufacturer's recommendations. The safety cable shall be located on the side of the tower adjacent to the driveway or most accessible approach to the tower.

103-3.4 LIGHTNING PROTECTION. The Contractor shall furnish and install a lightning rod, down conductor, and at least one ground plate or rod for each beacon tower. The lightning rod shall be installed at the top of the tower with the tip of the rod extending not less than 6 inches (150 mm) above the top of the beacon.

Down-conductor cables shall be securely fastened to the surface of the tower leg at 5-foot (150 cm) intervals with suitable bronze fasteners having bronze or noncorrosive metal bolts. Sharp turns or bends in the down conductor will not be permitted.

All connections of cable to cable, cable to lightning rods, and cable to ground plates or rods shall be made with approved type solderless connectors or noncorrosive metal and shall be of substantial construction.

The down-conductor cable shall be securely attached to ground rods or plates placed at least 2 feet (60 cm) away from the tower foundations. The ground rod shall be driven into the ground so that the top is at least 6 inches

(150 mm) below grade. The down-conductor shall be firmly attached to the ground plate or rod by means of a ground connector or clamp. Plates shall be embedded in the area of permanent moisture.

The complete lightning protection installation shall be accomplished to the satisfaction of the Engineer. The resistance to ground of any part of the lightning protection system shall not exceed 25 ohms.

103-3.5 PAINTING. The Contractor shall furnish all materials and labor for painting the beacon tower. The color scheme for the steel tower shall be as shown in the plans.

a. Parts to be Painted. Tower parts (except those parts to be exposed to earth) shall not be treated or primed before erection. All tower parts placed below ground level or within 12 inches (300 mm) above ground level shall be given two coats of approved bituminous paint.

The paint shall be applied uniformly in the proper consistency by skilled painters. The finished paint shall be free from sags, holidays, and smears. Division lines between colors shall be sharply defined. Each coat of paint shall be given ample time to dry and harden before the next coat is applied. A minimum of 4 days shall be allowed for drying on metal surfaces. Painting shall not be done in cold, damp, foggy, dusty, or frosty atmospheres, or when air temperature is below 40° F (4° C), nor started when the weather forecast indicates such conditions for the day.

All surfaces shall be cleaned before painting. The surfaces shall be dry and free from scale, grease, rust, dust, and dirt when paint is applied.

The number of coats of paint applied shall be in accordance with the following instructions:

b. Steel Towers, Galvanized. One priming coat of zinc dust-zinc oxide primer after erection and one body and one finish of white or orange paint (as required by the color scheme) applied after erection.

c. Steel Towers, Not Galvanized. One priming coat of corrosion-inhibiting primer and one body and one finish coat of white or orange paint (as required by the color scheme) applied after erection.

The above specified orange and white ready-mixed paints shall be thinned for the body coats in accordance with the manufacturer's recommendations. In the absence of such recommendations, the following shall apply:

d. Body Coats. Add not more than 1/2 pint (0.06 liters) of turpentine to each gallon (liter) of ready-mixed paint for body coats.

e. Finish Coats. The ready-mixed paint shall be used as it comes from the container for finish coats.

METHOD OF MEASUREMENT

103-4.1 The quantity to be paid for under this item shall be the number of airport beacon towers installed as completed units in place, accepted, and ready for operation.

BASIS OF PAYMENT

103 5.1 Payment will be made at the contract unit price for each completed and accepted job. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-103-5.1 Beacon Tower, in place-per unit

MATERIAL REQUIREMENTS

AC 150/5340-21	Airport Miscellaneous Lighting Visual Aids
Commercial Item	
Description. Spec A-A-3067	Paint: Alkyd, Exterior, Low VOC
Fed. Spec. TT-E-489	Enamel, Alkyd, Gloss, Low VOC Content
Fed. Std. 595	Colors
MIL-P-24441/19B	Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III

ITEM L-107 INSTALLATION OF AIRPORT 8-FOOT AND 12-FOOT WIND

DESCRIPTION

107-1.1 This item shall consist of furnishing and installing an airport wind cone in accordance with these specifications and in accordance with the dimensions, design, and details shown in the plans.

The work shall include the furnishing and installation of a support for mounting the wind cone, the specified wire, and a concrete foundation. The item shall also include all cable connections, conduit and conduit fittings, the furnishing and installation of all lamps, ground rod and ground connection, the testing of the installation, and all incidentals necessary to place the wind cone in operation as a completed unit to the satisfaction of the Engineer.

EQUIPMENT AND MATERIALS

107-2.1 GENERAL.

a. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall be certified and listed under Advisory Circular (AC) 150/5345-53, Airport Lighting Equipment Certification Program.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the Engineer.

107-2.2 WIND CONES. The 8-foot (240 cm) and 12-foot (3.5 m) wind cones and assemblies shall conform to the requirements of AC 150/5345-27, Specification for Wind Cone Assemblies.

107-2.3 WIRE. Wire in conduit rated up to 5,000 volts shall conform to AC 150/5345-7, Specification for L-824 Underground Cable for Airport Lighting Circuits, for rubber insulated neoprene covered wire, of Fed. Spec. J-C-30, Type RHW, for rubber insulated fibrous covered wire. For ratings up to 600 volts, thermoplastic wire conforming to Fed. Spec. J-C-30, Types TW, THW, and THWN, shall be used. The wires shall be of the type, size, number of conductors, and voltage shown in the plans or in the proposal.

107-2.4 CONDUIT. Rigid steel conduit and fittings shall conform to the requirements of Underwriters Laboratories Standard 6, 514, and 1242.

107-2.5 CONCRETE. The concrete for foundations shall be proportioned, placed, and cured in accordance with Item P-610, Structural Portland Cement Concrete.

107-2.6 PAINT.

a. Priming paint for ungalvanized metal surfaces shall be a high solids alkyd primer conforming to TT-P-664D.

b. Priming paint for galvanized metal surfaces shall be zinc dust-zinc oxide primer paint conforming to MIL-P-24441/19B. If necessary, add not more than ½ pint (0.06 liter) of turpentine to each gallon (liter).

c. Orange paint for the body and the finish coats on metal and wood surfaces shall consist of a ready-mixed nonfading paint meeting the requirements of Fed. Spec. TT-E-489. The color shall be in accordance with Federal Standards 595, Aviation Gloss Orange Number 12197.

d. White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to Commercial Item Description A-A-3067.

e. Priming paint for wood surfaces shall be mixed on the job by thinning the above specified aviation-orange or white paint by adding ½ pint (0.06 liter) of raw linseed oil to each gallon (liter).

CONSTRUCTION METHODS

107-3.1 INSTALLATION. The hinged support or hinged pole shall be installed on a concrete foundation as shown in the plans.

107-3.2 COUNTERWEIGHT. The Contractor shall furnish and install a counterweight on the hinged support for the 12-foot (3.5 m) wind cone. The counterweight may consist of lead weights which may be furnished with the “A” frame assembly or it may consist of concrete poured around the bottom of the hinged support. Where concrete is used, the counterweight shall be approximately 12 inches (300 mm) wide by 24 inches (600 mm) deep and should weigh approximately 500 pounds (230 kg). The counterweight should be 25 to 50 pounds (10 to 20 kg) less than the weight needed to balance the assembly. The counterbalancing should operate to the satisfaction of the Engineer.

107-3.2 ELECTRICAL CONNECTION. The Contractor shall furnish all labor and materials and shall make complete electrical connections in accordance with the wiring diagram furnished with the project plans.

If underground cable from the transformer vault to the wind cone site and duct for this cable installation under paved areas is required, the cable and duct shall be installed in accordance with and paid for by linear foot measurement as described in Item L-108, Installation of Underground Cables for Airports, and Item L-110, Installation of Airport Underground Electrical Duct.

107-3.4 BOOSTER TRANSFORMER. If shown in plans or specified in job specifications, a booster transformer to compensate for voltage drop to the lamps shall be installed in a suitable weatherproof housing. The booster transformer shall be installed as indicated in the plans and described in the proposal. If the booster transformer is required for installation in the transformer vault, it shall be installed in accordance with and paid for as described in Item L-109, Installation of Airport Transformer Vault and Vault Equipment.

107-3.5 GROUND CONNECTION AND GROUND ROD. The Contractor shall furnish and install a ground rod, grounding cable, and ground clamps for grounding the “A” frame of the 12-foot (3.5 m) assembly or pipe support of the 8-foot (240 cm) support near the base. The ground rod shall be of the diameter and length specified in the plans and shall be copper or copper clad. The ground rod shall be driven into the ground adjacent to the concrete foundation so that the top is at least 6 inches (150 mm) below grade. The grounding cable shall consist of No. 8 AWG bare stranded copper wire or larger and shall be firmly attached to the ground rod by means of a ground connector or clamp. The other end of the grounding cable shall be securely attached to a leg of the “A” frame or to the base of the pipe support with noncorrosive metal and shall be of substantial construction. The resistance to ground shall not exceed 25 ohms.

107-3.6 PAINTING. Three coats of paint shall be applied (one prime, one body, and one finish) to all exposed material installed under this item except the fabric cone, obstruction light globe, and lamp reflectors. The wind cone assembly, if painted on receipt, shall be given one finish coat of paint in lieu of the three coats specified above. The paint shall meet the requirements of Fed. Spec. TT-E-489. The color shall be in accordance with Federal Standard 595, Aviation Gloss Orange Number 12197.

107-3.7 LAMPS. The Contractor shall furnish and install four 200-watt, 115-volt general lighting service lamps in the reflectors for the 12-foot (3.5 m) cone or four 150-watt, 115-volt lamps for the 8-foot (240 cm) cone. A clear 100-watt, 107-watt, or 116-watt, 115-volt traffic signal lamp with a medium screw base, or a 100-watt. A 21 bulb, 115 volt, medium prefocus base lamp shall be furnished and installed in the obstruction light as required.

107-3.8 CHAIN AND PADLOCK. The Contractor shall furnish and install a suitable operating chain for lowering and raising the hinged top section. The chain shall be attached to the pole support in a manner to prevent the light fixture assembly from striking the ground in the lowered position.

A padlock shall also be furnished by the Contractor on the 8-foot (240 cm) wind cone for securing the hinged top section to the fixed lower section. keys for the padlock shall be delivered to the Engineer.

METHOD OF MEASUREMENT

107-4.1 The quantity to be paid for shall be the number of wind cones installed as completed units in place, accepted, and ready for operation.

BASIS OF PAYMENT

107-5.1 Payment will be made at the contract unit price for each completed and accepted job. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-107-5.1	12-Foot (3.5 m) Wind Cone, in place—per unit
----------------	--

Item L-107-5.2	8-Foot (240 cm) Wind Cone, in place—per unit
----------------	--

MATERIAL REQUIREMENTS

AC 150/5345-7	Specification for L-824 Underground Cable for Airport Lighting Circuits
---------------	---

AC 150/5345-27	Specification for Wind Cone Assemblies
----------------	--

Commercial Item Description. Spec A-A-3067	Paint: Alkyd, Exterior, Low VOC
---	---------------------------------

Fed. Spec. TT-E-489	Enamel, Alkyd, Gloss, Low VOC Content
---------------------	---------------------------------------

Fed. Spec. J-C-30	Cable and Wire, Electrical (Power, Fixed Installation)
-------------------	--

Fed. Spec. W-P-115	Panel, Power Distribution
--------------------	---------------------------

Fed. Std. 595	Colors
---------------	--------

MIL-P-24441/20	Paint, Epoxy-Polyamide, Green Primer, Formula 150, Type III
----------------	---

Underwriters Laboratories Standard 6	Rigid Metal Conduit
---	---------------------

Underwriters Laboratories Standard 514	Fittings For Conduit and Outlet Boxes
---	---------------------------------------

Underwriters Laboratories Standard 1242	Intermediate Metal Conduit
--	----------------------------

ITEM L-108 INSTALLATION OF UNDERGROUND CABLE FOR AIRPORTS

DESCRIPTION

108-1.1 This item shall consist of furnishing and installing underground cable in accordance with these specifications at the locations shown in the plans. This item shall include the excavation and backfill of the trench and the installation of cable and counterpoise wire in trench, duct or conduit. It shall include splicing, cable marking, and testing of the installation and all incidentals necessary to place the cable in operating condition as a completed unit to the satisfaction of the Engineer. This item shall not include the installation of the duct or conduit.

EQUIPMENT AND MATERIALS

Electro magnetic interference has been identified as a source of performance loss for certain airport systems and precautionary steps must be taken to reduce this possibility. Project contracts should include the requirement to test new systems and compare their compatibility to installed equipment. Operational tests should be preformed to ensure no increase in EMI occurs over the original findings.

108-2.1 GENERAL.

a. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall be certified and listed under Advisory Circular (AC) 150/5345-53, Airport Lighting Equipment Certification Program.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when requested by the Engineer.

108-2.2 CABLE. Underground cable shall conform to the requirements of AC 150/5345-7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits.

If telephone control cable is specified, copper shielded, polyethylene insulated and jacketed, No. 19 AWG telephone cable conforming to ICEA-S-85-625-1996, Standard, Aircore, Polyolefin, Copper Conductor Telecommunications Cable for direct burial, shall be used.

Where counterpoise conductors are to be installed and where soil conditions would adversely affect bare copper wire, thermoplastic wire conforming to Fed. Spec. J-C-30, Type TW, 600 volt, may be used.

Cable type, size, number of conductors, strand and service voltage shall be specified in the plans and/or proposal.

108-2.3 BARE COPPER WIRE (COUNTERPOISE). Bare copper wire for counter-poise installations shall be stranded wire conforming to ASTM Specifications B 3 and B 8.

108-2.4 CABLE CONNECTIONS. In-line connections of underground primary cables shall be of the type called for in the plans or in the proposal, and shall be one of the types listed below. When the plans or the proposal permit a choice of connection, the Contractor shall indicate in the bid the type of connection he proposes to furnish.

a. The Cast Splice. A cast splice, employing a plastic mold and using epoxy resin manufactured by Minnesota Mining and Manufacturing Company, "Scotchcast" Kit No. 82B, or equal, is used for potting the splice. This means of splicing is the only type approved for telephone control cable.

b. The Vulcanized Splice. A vulcanized splice with proper molds for various cable sizes shall be used.

c. The Field-attached Plug-in Splice. Figure 3 of AC 150/5345-26, Specification for L-823 Plug and Receptacle, Cable Connectors, employing connector kits, is approved for field attachment to single conductor cable.

d. The Factory-Molded Plug-in Splice. Specification for L-823 Connectors, Factory-Molded to Individual Conductors, are approved.

e. The Taped Splice. Taped splices employing field-applied rubber, or synthetic rubber tape covered with plastic tape are approved. The rubber tape should meet the requirements of ASTM D 4388 and the plastic tape should comply with Mil. Spec. MIL-I-24391 or Commercial Item Description A-A-55809. In all the above cases, connections of cable conductors shall be made using crimp connectors utilizing a crimping tool designed. To make a complete crimp before the tool can be removed, No. 19 AWG telephone control wires may be connected by means of wrapped and soldered splice, 3M Company Moisture Proof UR Type Connector, or equal, or by a method approved by the Engineer.

108-2.5 CONCRETE. Concrete for cable markers shall conform to Specification Item P-610, "Structural Portland Cement Concrete."

CONSTRUCTION METHODS

108-3.1 GENERAL. The Contractor shall install the specified cable at the approximate locations indicated in the airport lighting layout plans. The Engineer shall indicate specific locations.

Cable connections between lights will be permitted only at the light locations for connecting the underground cable to the primary leads of the individual insulating transformers. The Contractor shall be responsible for providing cable in continuous lengths for home runs or other long cable runs without connections, unless otherwise authorized in writing by the Engineer or shown in the plans.

108-3.2 INSTALLATION IN DUCT OR CONDUIT. This item includes the installation of the cable in duct or conduit as described below. The maximum number and voltage ratings of cables installed in each single duct or conduit, and the current-carrying capacity of each cable shall be in accordance with the latest National Electric Code, or the code of the local agency having jurisdiction.

The Contractor shall make no connections or joints of any kind in cables installed in conduits or ducts.

The duct or conduit shall be installed as a separate item in accordance with Item L-110, "Installation of Airport Underground Electrical Duct." The Contractor shall make sure that the duct is open, continuous, and clear of debris before installing cable. The cable shall be installed in a manner to prevent harmful stretching of the conductor, injury to the insulation, or damage to the outer protective covering. The ends of all cables shall be sealed with moisture-seal tape before pulling into the conduit and it shall be left sealed until connections are made. Where more than one cable is to be installed in a duct under the same contract, all cable shall be pulled in the duct at the same time. The pulling of a cable through ducts or conduits may be accomplished by handwinch or power winch with the use of cable grips or pulling eyes. Pulling tensions should be governed by recommended standard practices for straight pulls or bends. A lubricant recommended for the type of cable being installed shall be used where pulling lubricant is required. Duct or conduit markers temporarily removed for excavations shall be replaced as required.

108-3.3 TRENCHING. Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored. Trenches for cables may be excavated manually or with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Road patrols or graders shall not be used to excavate the trench with their blades. The bottom surface of trenches shall be essentially smooth and free from coarse aggregate. Unless otherwise specified, cable trenches shall be excavated to a minimum depth of 18 inches (45 cm) below finished grade, except as follows:

a. When off the airport or crossing under a roadway or driveway, the minimum depth shall be 36 inches (90 cm) unless otherwise specified.

b. Minimum cable depth when crossing under a railroad track, shall be 42 inches (105 cm) unless otherwise specified.

The Contractor shall excavate all cable trenches to a width not less than 6 inches (150 mm). The trench shall be widened where more than two cables are to be installed parallel in the same trench. Unless otherwise specified in the plans, all cables in the same location and running in the same general direction shall be installed in the same trench.

When rock excavation is encountered, the rock shall be removed to a depth of at least 3 inches (75 mm) below the required cable depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a ¼-inch (6 mm) sieve. The Contractor shall ascertain the type of soil or rock to be excavated before bidding. All excavation shall be unclassified.

108-3.4 INSTALLATION IN TRENCHES. The Contractor shall not use a cable plow for installing the cable. Mechanical cable-laying equipment may be used in conjunction with a trenching machine if specified on project plans and specifications; and it should provide for physical inspection of cable prior to backfilling. Sharp bends or kinks in the cable shall not be permitted.

Cables shall be unreeled in place alongside or in the trench and shall be carefully placed along the bottom of the trench. The cable shall not be unreeled and pulled into the trench from one end.

Where two or more cables are laid parallel in the same trench, they shall be placed laterally a minimum distance of 3 inches (75 mm) apart, and the trench shall be widened sufficiently to accomplish this.

Cables crossing over each other shall have a minimum of 3-inch (75 mm) vertical displacement with the topmost cable depth at or below the minimum required depth below finished grade.

Not less than 1 foot (30 cm) of cable slack shall be left on each side of all connections, insulating transformers, light units, and at all other points where cable is connected to field equipment. The slack cable shall be placed in the trench in a series of S curves. Additional slack cable shall be left in runway light bases, handholes, manholes, etc., where it is required to bring the cable above ground level to make connections. The amount of slack cable shall be stipulated by the Engineer, or as shown in the plans and specifications.

108-3.5 BACKFILLING. After the cable has been installed, the trench shall be 3 inches (75 mm) deep, loose measurement, and shall be either earth or sand containing no mineral aggregate particles that would be retained on a ¼-inch (6 m) sieve. This layer shall not be compacted. The second layer shall be 5 inches (125 mm) deep, loose measurement, and shall contain no particles that would be retained on a 1-inch (25.0 mm) sieve. The remainder of the backfill shall be excavated or imported mineral and shall not contain stone or aggregate larger than 4 inches (100 mm) maximum diameter. The third and subsequent layers of the backfill shall not exceed 8 inches (200 mm) in maximum depth, loose measurement.

The second, and subsequent layers shall be thoroughly tamped and compacted to at least the density of the adjacent undisturbed soil, and to the satisfaction of the Engineer. If necessary to obtain the desired compaction, the backfill material shall be moistened or aerated as required.

Trenches shall not be excessively wet and shall not contain pools of water during backfilling operations. The trench shall be completely backfilled and tamped level with the adjacent surface, except that when sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement. Any excess excavated material shall be removed and disposed of in accordance with instructions issued by the Engineer.

108-3.6 RESTORATION. Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the trenching, storing of dirt, cable laying, pad construction, and other work shall be restored to its original condition. The restoration shall include any necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging or mulching. All such work shall be performed in accordance with

the FAA standard turfing specifications. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance.

108-3.7 CABLE MARKERS. The location of runway light circuits shall be marked by a concrete slab marker, 2 feet (60 cm) square and 4 inches (100 mm) thick, extending approximately 1 inch (25 mm) above the surface. Each cable run from the line of runway lights to the equipment vault shall also be marked at approximately every 200 feet (60 m) along the cable run, with an additional marker at each change of direction of cable run. All other cable buried directly in the earth shall be marked in the same manner. The Contractor shall not install slab markers where cable lies in straight lines between obstruction light poles which are spaced 300 feet (90 m) apart, or less. Cable markers shall be installed immediately above the cable. The Contractor shall impress the word "cable" and directional arrows on each cable marking slab. The letters shall be approximately 4 inches (100 mm) high and 3 inches (75 mm) wide, with width of stroke 1/2 inch (12 mm) and 1/4 inch (6 mm) deep.

The location of each underground cable connection, except at lighting units or insulating transformers, shall be marked by a concrete marker slab placed above the connection. The Contractor shall impress the word "splice" on each slab. He also shall impress additional circuit identification symbols on each slab if so desired by the Engineer.

108-3.8 SPLICING. Connections of the type shown in the plans shall be made by experienced personnel regularly engaged in this type of work and shall be made as follows:

a. Cast Splices. These shall be made by using crimp connectors for jointing conductors. Molds shall be assembled, and the compound shall be mixed and poured in accordance with manufacturer's instructions and to the satisfaction of the Engineer.

b. Vulcanized Splices. These shall be made by using crimp connectors for joining conductors. The splice shall be made, using compounds furnished by the manufacturer, in accordance with his/her instructions and to the satisfaction of the Engineer.

c. Field-attached Plug-in Splices. These shall be assembled in accordance with manufacturer's instructions. These splices shall be made by plugging directly into mating connectors. In all cases the joint where the connectors come together shall be wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches (37 mm) on each side of the joint.

d. Factory-Molded Plug-in Splices. These shall be made by plugging directly into mating connectors. In all cases, the joint where the connectors come together shall be wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches (37 mm) on each side of the joint.

e. Taped Splices. A taped splice shall be made in the following manner:

Bring the cables to their final position and cut so that the conductors will butt. Remove insulation and jacket allowing for bare conductor of proper length to fit compression sleeve connector with 1/4 inch (6 mm) of bare conductor on each side of the connector. Use a sharp knife to pencil insulation and jacket at approximately the same angle as a pencil point. Care must be taken to avoid nicking or injuring the conductor during removal of insulation or penciling. Do not use emery paper on splicing operation since it contains metallic particles. The copper conductors shall be thoroughly cleaned. Join the conductors by inserting them equidistant into the compression connection sleeve. Crimp conductors firmly in place with crimping tool that requires a complete crimp before tool can be removed. Test the crimped connection by pulling on the cable. Scrape the insulation to assure that the entire surface over which the tape will be applied (plus 3 inches (75 mm) on each end) is clean. After scraping wipe the entire area with a clean lint free cloth. Do not use solvents.

Apply high-voltage rubber tape one-half lapped over bare conductor. This tape should be tensioned as recommended by the manufacturer. Voids in the connector area may be eliminated by highly elongating the tape stretching it just short of its breaking point. Throughout the rest of the splice less tension should be used. Always attempt to exactly half-lap to produce a uniform buildup. Continue buildup to 1-1/2 times cable diameter over the body of the splice with ends tapered a distance of approximately 1 inch (25 mm) over the original jacket. Cover rubber tape with two layers of vinyl pressure-sensitive tape one-half lapped. Do not use glyptol or lacquer over vinyl tape as they react as solvents to the tape. No further cable covering or splice boxes are required.

If shielded cable is to be spliced, prepare cable as for a regular taped splice, except that the neoprene jacket shall be removed a distance not less than 5 inches (125 mm) from the beginning of the penciled portion. Carefully unwrap

the shielding tape from that portion where jacket has been removed and cut off so that it extends about 1 inch (25 mm) from end of the jacket. Proceed with the taped splice as described above and tape up to 1/4 inch (6 mm) from the shield on both ends. Build up rubber tape to a thickness equal to the insulation thickness or 5/16 inch (9 mm) over connector.

Next wrap one-half lapped layer of semi-conducting tape (Scotch No. 13 Semi-Conducting Tape, or equal) over splicing tape and 1/4 inch (6 mm) onto the shielding tape. Wrap a fine, flat shielding braid one-half lapped over the splice extending 1/2 inch (12 mm) onto the metallic shielding. Solder ends of braid to metallic shielding tape. A bonding wire, (Minimum No. 14 Stranded Copper) equal to the current carrying capacity of the metallic shield, should have the individual strands wrapped around the metallic shield at both ends of the splice. These strands should be tack soldered to the shield in several places. The cable sheath should be replaced by wrapping with two one-half lapped layers of vinyl tape extending 2 inches (50 mm) onto the cable jacket.

The above described splice is for a straight-through splice with continuity of shielding.

108-3.9 BARE COUNTERPOISE WIRE INSTALLATION AND GROUNDING FOR LIGHTNING PROTECTION. If shown in the plans or specified in job specifications, a stranded bare copper wire, No. 8 AWG minimum size, shall be installed for lightning protection of the underground cables. The bare counterpoise wire shall be installed in the same trench for the entire length of the insulated cables it is designed to protect, and shall be placed at a distance of approximately 4 inches (100 mm) from the insulated cable. The counterpoise wire shall be securely attached to each light fixture base, or mounting stake. The counterpoise wire shall also be securely attached to copper or copper-clad ground rods installed not more than 1,000 feet (300 m) apart around the entire circuit. The ground rods shall be of the length and diameter specified in the plans, but in no case shall they be less than 8-feet (240 cm) long nor less than 5/8 inch (15 mm) in diameter.

The counterpoise system shall terminate at the transformer vault or at the power source. It shall be securely attached to the vault or equipment grounding system. The connections shall be made as shown in the project plans and specifications.

108-3.10 TESTING. The Contractor shall furnish all necessary equipment and appliances for testing the underground cable circuits after installation. The Contractor shall test and demonstrate to the satisfaction of the Engineer the following:

- a. That all lighting power and control circuits are continuous and free from short circuits.
- b. That all circuits are free from unspecified grounds.
- c. That the insulation resistance to ground of all nongrounded series circuits is not less than 50 megohms.
- d. That the insulation resistance to ground of all nongrounded conductors of multiple circuits is not less than 50 megohms.
- e. That all circuits are properly connected in accordance with applicable wiring diagrams.
- f. That all circuits are operable. Tests shall be conducted that include operating each control not less than 10 times and the continuous operation of each lighting and power circuit for not less than 1/2 hour.

METHOD OF MEASUREMENT

108-4.1 Trenching shall be measured by the linear feet (meters) of trench, including the excavation, backfill, and reconditioning, completed, measured as excavated, and accepted as satisfactory.

When specified in the proposal, separate measurement shall be made for trenches of various specified widths.

108-4.2 Cable or counterpoise wire installed in trench shall be measured by the number of linear feet (meters) of cable or counterpoise wire installed in trenches, ready for operation, and accepted as satisfactory. Separate measurement shall be made for each cable or counterpoise wire installed in trench.

108-4.3 Cable or counterpoise wire installed in duct or conduit shall be measured by the number of linear feet (meters) measured in place, completed, ready for operation, and accepted as satisfactory.

Separate measurement shall be made for each cable or counterpoise wire installed in duct or conduit.

BASIS OF PAYMENT

108-5.1 Payment will be made at the contract unit price for trenching cable and bare counterpoise wire installed in trench or duct in place by the Contractor and accepted by the Engineer. This price shall be full compensation for furnishing all materials and for all preparation and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-108-5.1 Cable Trench-per linear foot (meter)

Item L-108-5.2 Underground Cable, installed in trench-per linear foot (meter)

Item L-108-5.3 Underground Cable, installed in duct or conduit-per linear foot (meter)

Item L-108-5.4 Bare Counterpoise Wire, installed in trench, including ground rods and ground connectors-per linear foot (meter)

Item L-108-5.5 Bare Counterpoise Wire, installed in duct-per linear foot (meter)

MATERIAL REQUIREMENTS

AC 150/5345-7 Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits

AC 150/5345-26 Specification for L-823 Plug and Receptacle Cable Connectors

ASTM B 3 Soft or Annealed Copper Wire

ASTM B 8 Concentric-Lay-Stranded Copper Conductor, Hard, Medium-Hard, or Soft

ASTM D 4388 Rubber Tapes, Nonmetallic Semi-Conducting and Electrically Insulating

Commercial Item
Description A-A-55809 Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic

Fed. Spec. J-C-30 Cable and Wire, Electrical Power, Fixed Installation

MIL-I-24391 Insulation Tape, Electrical, Plastic, Pressure-Sensitive

ITEM L-109 INSTALLATION OF AIRPORT TRANSFORMER VAULT AND VAULT EQUIPMENT

DESCRIPTION

109-1.1 This item shall consist of constructing an airport transformer vault or a prefabricated metal housing these specifications in accordance with the design and dimensions shown in the plans. This work shall also include the installation of conduits in floor and foundation, painting and lighting of the vault or metal housing, and the furnishing of all incidentals necessary to produce a completed unit. Included as a separate part under this item or as a separate item where an existing vault is to be utilized shall be the furnishing of all vault equipment, wiring, electrical buses, cable, conduit, potheads, and grounding systems. This work shall also include the painting of equipment and conduit; the marking and labeling of equipment and the labeling or tagging of wires; the testing of the installation; and the furnishing of all incidentals necessary to place it in operating condition as a completed unit to the satisfaction of the Engineer.

EQUIPMENT AND MATERIALS

109-2.1 GENERAL.

a. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall be certified and listed under Advisory Circular (AC) 150/5345-53, Airport Lighting Equipment Certification Program.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the Engineer.

CONSTRUCTION OF VAULT AND PREFABRICATED METAL HOUSING

109-2.2 CONCRETE. The concrete for the vault shall be proportioned, placed, and cured in accordance with Item P-610, Structural Portland Cement Concrete, using ¾-inch (18 mm) maximum size coarse aggregate.

109-2.3 REINFORCING STEEL. Reinforcing steel bars shall be intermediate or structural grade deformed-type bars and shall meet the requirements of ASTM A 615.

109-2.4 BRICK. Brick shall conform to ASTM C 62, Grade SW.

109-2.5 ASBESTOS CEMENT DUCT. Asbestos cement duct and fittings shall be in accordance with Fed. Spec. W-C-571.

109-2.6 RIGID STEEL CONDUIT. Rigid steel conduit and fittings shall be in accordance with Underwriters Laboratories Standard 6 and 514.

109-2.7 LIGHTING. Vault or metal-housing light fixtures shall be of a vaporproof type.

109-2.8 OUTLETS. Convenience outlets shall be heavy-duty duplex units designed for industrial service.

109-2.9 SWITCHES. Vault or metal-housing light switches shall be single-pole switches.

109-2.10 PAINT.

a. Priming paint for ungalvanized metal surfaces shall be a high solids alkyd primer conforming to TT-P-664D.

b. White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to Commercial Item Description A-A-3067.

c. Priming paint for wood surfaces shall be mixed on the job by thinning the above specified white paint by adding 1/2 pint (0.06 liter) of raw linseed oil to each gallon (liter).

d. Paint for the floor, ceiling, and inside walls shall be in accordance with Fed. Spec. TT-E-487. Walls and ceiling shall be light gray and the floor shall be medium gray.

e. The roof coating shall be hot asphalt material in accordance with ASTM D 2823.

109-2.11 HIGH-VOLTAGE BUS. High-voltage bus shall be standard weight 3/8-inch (9 mm) IPS copper tubing or it may be insulated copper cable of the size and voltage rating specified.

109-2.12 BUS CONNECTORS. Connectors shall be similar to Burndy Type NT (or equal) for copper tubing. Connectors for insulated bus cable shall be of the proper size and type for the service intended.

109-2.13 BUS SUPPORTS. Bus supports shall be similar to Westinghouse No. 527892 (or equal), insulated for 7,500 volts, single clamp type for 2-bolt flat mounting.

109-2.14 GROUND BUS. Ground bus shall be 3/4-inch (3 x 18 mm) copper bus bar.

109-2.15 SQUARE DUCT. Duct shall be square similar to that manufactured by the Square D Company (or equal), or the Trumbull Electric Manufacturing Company (or equal). The entire front of the duct on each section shall consist of hinged or removable cover for ready access to the interior. The cross section of the duct shall be not less than 4 x 4 inches (100 x 100 mm) except where otherwise shown in the plans.

109-2.16 GROUND RODS. Ground rods shall be copper or copper-clad of the length and diameter specified in the plans.

109-2.17 POTHEADS. Potheads shall be similar to G&W Type N, Shape C (or equal), unless otherwise specified. Potheads shall be furnished with plain insulator bushings and conduit couplings. Potheads shall have a rating not less than the circuit voltage.

109-2.18 PREFABRICATED METAL HOUSING. The prefabricated metal housing shall be a commercially available unit.

109-2.19 FAA-APPROVED EQUIPMENT. Certain items of airport lighting equipment installed in vaults are covered by individual FAA equipment specifications. The specifications are listed below:

AC 150/5345-3 Specification for L-821 Panels for Remote Control of Airport Lighting

AC 150/5345-5 Circuit Selector Switch

AC 150/5345-7 Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits

AC 150/5345-10 Specification for Constant Current Regulators and Regulator Monitors

AC 150/5345-13 Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits.

109-2.20 OTHER ELECTRICAL EQUIPMENT. Constant-current regulators, distribution transformers, oil switches, cutouts, relays, terminal blocks, transfer relays, circuit breakers, and all other regularly used commercial items of electrical equipment not covered by FAA equipment specifications shall conform to the applicable rulings and standards of the Institute of Electrical and Electronic Engineers or the National Electrical Manufacturers

Association. When specified, test reports from a testing laboratory indicating that the equipment meets the specifications shall be supplied. In all cases, equipment shall be new and a first-grade product. This equipment shall be supplied in the quantities required for the specific project and shall incorporate the electrical and mechanical characteristics specified in the proposal and plans.

109-2.21 WIRE. Wire in conduit rated up to 5,000 volts shall conform to AC 150/5345-7, Specification for L-824 Underground Electrical Cables for Airport Lighting Circuits, for rubber insulated neoprene-covered wire, or Fed. Spec. J-C-30, Type RHW, for rubber insulated fibrous-covered wire. For ratings up to 600 volts, thermoplastic wire conforming to Fed. Spec. J-C-30, Types TW, THW, and THWN, shall be used. The wires shall be of the type, size, number of conductors, and voltage shown in the plans or in the proposal.

a. Control Circuits. Wire shall be not less than No. 12 AWG and shall be insulated for 600 volts. If telephone control cable is specified, No. 19 AWG telephone cable conforming to ICEA S-85-625-1996 specifications shall be used.

b. Power Circuits.

(1) 600 volts maximum-Wire shall be No. 6 AWG or larger and insulated for at least 600 volts.

(2) 3,000 volts maximum-Wire shall be No. 6 AWG or larger and insulated for at least 3,000 volts.

(3) Over 3,000 volts-Wire shall be No. 6 AWG or larger and insulated for at least the circuit voltage.

CONSTRUCTION METHODS

CONSTRUCTION OF VAULT AND PREFABRICATED METAL HOUSING

109-3.1 GENERAL. The Contractor shall construct the transformer vault or prefabricated metal housing at the location indicated in the plans. Vault construction shall be reinforced concrete, concrete masonry, or brick wall as specified. The metal housing shall be prefabricated equipment enclosure to be supplied in the size specified. The mounting pad or floor details, installation methods, and equipment placement are shown in the plans.

The Contractor shall clear, grade, and seed the area around the vault or metal housing for a minimum distance of 10 feet (3 m) on all sides. The slope shall be not less than ½-inch per foot (40 mm per m) away from the vault or metal housing in all directions.

109-3.2 FOUNDATION AND WALLS.

a. Reinforced Concrete Construction. The Contractor shall construct the foundation and walls in accordance with the details shown in the plans. Unless otherwise specified, internal ties shall be of the mechanical type so that when the forms are removed the ends of the ties shall be at least 1-inch (25 mm) beneath the concrete surface; the holes shall be plugged and finished to prevent discoloration. Reinforcing steel shall be placed, as shown in the drawings, and secured in position to prevent displacement during the concrete placement.

The external surfaces of the concrete shall be thoroughly worked during the placing operation to force all coarse aggregate from the surface. Thoroughly work the mortar against the forms to produce a smooth finish free from air pockets and honeycomb.

The surface film of all pointed surfaces shall be removed before setting occurs. As soon as the pointing has set sufficiently, the entire surface inside and outside of the vault shall be thoroughly wet with water and rubbed with a No. 16 carborundum stone, or equal quality abrasive, bringing the surface to a paste. All form marks and projections shall be removed. The surface produced shall be smooth and dense without pits or irregularities. The materials which have been ground into a paste during the rubbing process shall be spread or brushed uniformly over the entire surface (except the interior surfaces that are to be painted shall have all paste removed by washing before painting) and permitted to reset. Final exterior finish shall be obtained by rubbing with No. 30 carborundum stone, or an equal quality abrasive. The surface shall be rubbed until the entire surface is smooth and uniform in color.

b. Brick and Concrete Construction. When this type of construction is specified, the foundation shall be concrete conforming to the details shown in the plans. The outer edge of the foundation at the floor level shall be beveled 1-½ inches (37 mm) at 45 degrees. Brick walls shall be 8 inches (200 mm) thick, laid in running bond with every sixth course a header course. Brick shall be laid in cement mortar (1 part masonry cement and 3 parts sand) with full mortar bed and shoved joints. All joints shall be completely filled with mortar, and facing brick shall be back-parged with mortar as work progresses. All joints shall be 3/8 inch (9 mm) thick, exterior joints tooled concave, and interior joints struck flush. Both interior and exterior brick surfaces shall be cleaned and nail holes, cracks and other defects filled with mortar. When specified, a nonfading mineral pigment mortar coloring shall be added to the mortar. Steel reinforcing bars, ¾-inch (9 mm) in diameter and 12 inches (300 mm) long, shall be set vertically in the center of the brick wall on not more than 2-foot (60 cm) centers to project 2-½ (60 mm) inches into the concrete roof slab. Lintels for supporting the brickwork over doors, windows, and louvers shall consist of two 4- x 3- x ¾-inch (100 x 75 x 9 mm) steel angles. Lintels shall be painted with one coat of corrosion-inhibiting primer before installation, and all exposed parts shall be painted similar to doors and window sash after installation.

Window sills may be concrete poured in place or precast concrete as indicated in the plans. All exposed surfaces shall have a rubbed finish as specified under reinforced concrete construction. After completion, all interior and exterior faces of walls shall be scrubbed with a solution of muriatic acid and water in the proportions of not less than 1 part acid to 10 parts of water. All traces of efflorescence, loose mortar, and mortar stain shall be removed, and the walls washed down with clear water.

c. Concrete Masonry Construction. When this type of construction is specified, the foundation shall be concrete conforming to the details shown in the plans. The concrete masonry units shall be standard sizes and shapes and shall conform to ASTM C 90 and shall include the closures, jambs, and other shapes required by the construction as shown in the plans. Standard construction practice shall be followed for this type of work including mortar, joints, reinforcing steel for extensions into roof slab, etc. Plaster for interior walls, if specified, shall be portland cement plaster.

109-3.3 ROOF. The roof shall be reinforced concrete as shown in the plans. Reinforcing steel shall be placed as shown in the drawing and secured in position to prevent displacement during the pouring of the concrete. The concrete shall be poured monolithically and shall be free of honeycombs and voids. The surface shall have a steel-troweled finish and shall be sloped as shown in the drawing. The underside of the roof slab shall be finished in the same manner as specified for walls.

One brush or mop coat of hot asphalt roof coating shall be applied to the top surface of the roof slab. The asphalt material shall be heated to within the range specified by the manufacturer and immediately applied to the roof. The finished coat shall be continuous over the roof surface and free from holidays and blisters. Smears and dribbles of asphalt on the roof edges and building walls shall be removed.

109-3.4 FLOOR. The floor shall be reinforced concrete as shown in the drawings. When present, all sod, roots, refuse, and other perishable material shall be removed from the area under the floor to a depth of 8 inches (200 mm), unless a greater depth is specified in the invitation for bids. This area shall be backfilled with materials consisting of sand, cinders, gravel, or stone. Fill shall be placed in layers not to exceed 4 inches (100 mm) and shall be thoroughly compacted by tamping or rolling. A layer of building paper shall be placed over the fill prior to placing concrete. The floor surfaces shall have a steel-troweled finish. The floor shall be level unless a drain is specified, in which case the floor shall be pitched ¼-inch (6 mm) per foot downward toward the drain. A ¼-inch (6 mm) asphalt felt expansion joint shall be placed between floor and foundation walls. The floor shall be poured monolithically and shall be free of honeycombs and voids.

109-3.5 FLOOR DRAIN. If shown in the plans, a floor drain and dry well shall be installed in the center of the floor of the equipment room. The dry well shall be excavated 4 x 4 feet (120 x 120 cm) square and to a depth of 4 feet (120 cm) below the finished floor elevation and shall be backfilled to the elevation of the underside of the floor with gravel - which shall all pass a 2-inch (50 mm) mesh sieve and shall all be retained on a ¼-inch (6 mm) mesh sieve. The gravel backfill shall be placed in 6-inch (150 mm) maximum layers, and the entire surface of each layer shall be tamped either with a mechanical tamper or with a hand tamper weighing not less than 25 pounds (11 kg) and having a face area of not more than 36 square inches (234 square cm) nor less than 16 square inches (104 square cm). The drain inlet shall be set flush in the concrete floor. The drain shall have a clear opening of not less than 8 inches (200 mm) in diameter.

109-3.6 CONDUITS IN FLOOR AND FOUNDATION. Conduits shall be installed in the floor and through the foundation walls in accordance with the details shown in the plans. All underground conduit shall be painted with a bituminous compound. Conduit shall be installed with a coupling or metal conduit adapter flush with the top of the floor. All incoming conduit shall be closed with a pipe plug to prevent the entrance of foreign material during construction. Space conduit entrances shall be left closed.

109-3.7 DOORS. Doors shall be metal-clad fireproof class a doors conforming to requirements of the National Electric Code and local electrical codes.

109-3.8 PAINTING. The floor, ceiling, and inside walls of concrete construction shall first be given a hardening treatment, after which the Contractor shall apply two coats of paint as specified below, except that interior face brick walls need not be painted. The hardening treatment shall consist of applying two coats of either a commercial floor hardener or a solution made by dissolving 2 pounds (0.9 kg) of magnesium fluosilicate or zinc sulphate crystals in 1 gallon (liter) of water. Each coat shall be allowed to dry at least 48 hours before the next application. After the second treating coat has dried, the surfaces shall be brushed clean of all crystals and thoroughly washed with clear water. Paint for walls and ceiling shall be a light gray color approved by the Engineer. The floor paint shall be a medium gray color approved by the Engineer. Before painting, the surfaces shall be dry and clean. The first coat shall be thinned by adding 2/3-quart (0.166 liters) of spar varnish and 1/3-quart (0.083 liters) of turpentine to each gallon (liter) of paint. The second coat shall be applied without thinning. All doors, lintels, and windows shall be cleaned to remove any rust or foreign material and shall be given one body and one finish coat of white paint. Bare metal surfaces shall be given a prime coat of corrosion-inhibiting primer prior to the body and finish coats.

109-3.9 LIGHTS AND SWITCHES. The Contractor shall furnish and install a minimum of two duplex convenience outlets in the vault room. Where a control room is specified, at least two duplex outlets shall be installed.

INSTALLATION OF EQUIPMENT IN VAULT OR PREFABRICATED METAL HOUSING

109-3.10 GENERAL. The Contractor shall furnish, install, and connect all equipment, equipment accessories, conduit, cables, wires, buses, grounds, and support necessary to insure a complete and operable electrical distribution center for the airport lighting system as specified herein and shown in the plans. When specified, an emergency power supply and transfer switch shall be provided and installed.

The equipment installation and mounting shall comply with the requirements of the National Electrical Code and local code agency having jurisdiction.

109-3.11 POWER SUPPLY EQUIPMENT. Transformers, regulators, booster transformers, and other power supply equipment items shall be furnished and installed at the location shown in the plans or as directed by the Engineer. The power supply equipment shall be set on steel "H" sections, "I" beams, channels, or concrete blocks to provide a minimum space of 1-½ inches (37 mm) between the equipment and the floor. The equipment shall be placed so as not to obstruct the oil-sampling plugs of the oil-filled units; and name-plates shall, so far as possible, not be obscured.

If specified in the plans and specifications, equipment for an alternate power source or an emergency power generator shall be furnished and installed. The alternate power supply installation shall include all equipment, accessories, an automatic changeover switch, and all necessary wiring and connections. The emergency power generator set shall be the size and type specified.

109-3.12 SWITCHGEAR AND PANELS. Oil switches, fused cutouts, relays, transfer switches, panels, panel boards, and other similar items shall be furnished and installed at the location shown in the plans or as directed by the Engineer. Wall or ceiling mounted items shall be attached to the wall or ceiling with galvanized bolts of not less than ¾-inch (9 mm) diameter engaging metal expansion shields or anchors in masonry or concrete vaults.

109-3.13 DUCT AND CONDUIT. The Contractor shall furnish and install square-type exposed metallic ducts with hinged covers for the control circuits in the vault. These shall be mounted along the walls behind all floor-

mounted equipment and immediately below all wall-mounted equipment. The hinged covers shall be placed to open from the front side with the hinges at the front bottom.

Wall brackets for square ducts shall be installed at all joints 2 feet (60 cm) or more apart with intermediate brackets as specified. Conduit shall be used between square ducts and equipment or between different items of equipment when the equipment is designed for conduit connection. When the equipment is not designed for conduit connection, conductors shall enter the square-type control duct through insulating bushings in the duct or on the conduit risers.

109-3.14 CABLE ENTRANCE AND HIGH-VOLTAGE BUS SYSTEM. Incoming underground cable from field circuits and supply circuits will be installed outside the walls of the transformer vault as a separate item under Item L-108. The Contractor installing the vault equipment shall bring the cables from the trench or duct through the entrance conduits into the vault and make the necessary electrical connections. For the incoming and outgoing high voltage load circuits, the Contractor shall furnish and install rigid metallic vi conduit risers, surmounted by potheads, from floor level to the level as shown in the plans.

The incoming high-voltage power supply service to the vault shall enter below the floor of the vault and shall rise from the floor level in a rigid metallic conduit riser, surmounted by a pothead, as described above. Using insulated high-voltage cable, the incoming power service shall be connected from the pothead to the oil-fused cutouts or to the specified disconnecting switch or equipment. From the oil-fused cutouts or disconnecting device, the insulated service conductors shall be connected to the overhead voltage bus system of the vault. The high-voltage bus system shall utilize the materials specified and shall be mounted and installed in accordance with the requirements of the National Electrical Code or the local code agency having jurisdiction.

109-3.15 WIRING AND CONNECTIONS. The Contractor shall make all necessary electrical connections in the vault in accordance with the wiring diagrams furnished and as directed by the Engineer. In wiring to the terminal blocks, the Contractor shall leave sufficient extra length on each control lead to make future changes in connections at the terminal block. This shall be accomplished by running each control lead the longest way around the box to the proper terminal. Leads shall be neatly laced in place.

109-3.16 MARKING AND LABELING. All equipment, control wires, terminal blocks, etc., shall be tagged, marked, or labeled as specified below:

a. Wire Identification. The Contractor shall furnish and install self-sticking wire labels or identifying tags on all control wires at the point where they connect to the control equipment or to the terminal blocks. Wire labels, if used, shall be of the self-sticking preprinted type and of the manufacturer's recommended size for the wire involved. Identification -markings designated in the plans shall be followed. Tags, if used, shall be of fiber not less than 3/4-inch (13 mm) in diameter and not less than 1/32-inch (1 mm) thick. Identification markings designated in the plans shall be stamped on tags by means of smalltool dies. Each tag shall be securely tied to the proper wire by a nonmetallic cord.

b. Labels. The Contractor shall stencil identifying labels on the cases of regulators, breakers, and distribution and control relay cases with white oil paint as designated by the Engineer. The letters and numerals shall be not less than 1 inch (25 mm) in height and shall be of proportionate width. The Contractor shall also mark the correct circuit designations in accordance with the wiring diagram on the terminal marking strips, which are a part of each terminal block.

METHOD OF MEASUREMENT

109-4.1 The quantity of vaults to be paid for under this item shall consist of the number of vaults constructed in place and accepted as a complete unit.

109-4.2 The quantity of prefabricated metal housings to be paid for under this item shall consist of the number of housings constructed in place and accepted as a complete unit.

109-4.3 The quantity of vault or prefabricated metal housing equipment to be paid for under this item shall consist of all equipment installed, connected, and accepted as a complete unit ready for operation.

BASIS OF PAYMENT

109-5.1 Payment will be made at the contract unit price for each completed and accepted vault or prefabricated metal housing equipment installation. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item L-109-5.1	Construction of Airport Transformer Vault in Place-per unit
Item L-109-5.2	Installation of Airport Transformer Vault Equipment in Place-per unit
Item L-109-5.3	Construction of Prefabricated Metal Housing and Foundation in Place-per unit
Item L-109-5.4	Installation of Prefabricated Metal Housing Equipment in Place-per unit

MATERIAL REQUIREMENTS

AC 150/5345-3	Specification for L-821 Panels for Remote Control of Airport Lighting
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-10	Specification for Constant Current Regulators and Regulator Monitors
AC 150/5345-13A	Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits
ANSI/ICEA S-85-625-1996	Aircore, Polyethylene Insulated, Copper Conductor, Telecommunications Cable
ASTM A 615	Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement
ASTM C 62	Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 90	Concrete Masonry Units, Loadbearing
ASTM D 2823	Asphalt Roof-Coating
Commercial Item Description A-A-3067	Paint: Alkyd, Exterior, Low VOC
Fed. Spec. J-C-30	Cable and Wire, Electrical (Power, Fixed Installation)
Fed. Spec. TT-E-487	Enamel, Floor and Deck
Fed. Spec. W-C-571	Conduit and Fittings, Nonmetal, Rigid; (Asbestos-Cement or Fire-Clay Cement), (For Electrical Purposes)

ITEM L-110 INSTALLATION OF AIRPORT UNDERGROUND ELECTRICAL DUCT

DESCRIPTION

110-1.1 This item shall consist of underground electrical ducts installed in accordance with this specification at the locations and in accordance with the dimensions, designs, and details shown in the plans. This item shall include the installation of all underground electrical ducts or underground conduits. It shall also include all trenching, backfilling, removal, and restoration of any paved areas; manholes, concrete encasement, mandreling installation of steel drag wires and duct markers, capping, and the testing of the installation as a completed duct system ready for installation of cables, to the satisfaction of the Engineer.

EQUIPMENT AND MATERIALS

110-2.1 GENERAL. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when so requested by the Engineer.

110-2.2 BITUMINOUS FIBER DUCT. Bituminous fiber duct and fittings shall conform to the requirements of Underwriters Laboratories Standard 543.

a. Type I, for concrete encasement.

b. Type II, for direct burial.

110-2.3 ASBESTOS CEMENT DUCT. Asbestos cement duct and fittings shall conform to the requirements of Fed. Spec. W-C-571 and shall be one of the following, as specified in the proposal:

a. Type I, for concrete encasement.

b. Type II, for direct burial.

110-2.5 STEEL CONDUIT. Rigid steel conduit and fittings shall conform to the requirements of Underwriters Laboratories Standard 6, 514, and 1242.

110-2.6 CONCRETE. Concrete shall conform to Item P-610, Structural Portland Cement Concrete, using 1-inch (25 mm) maximum size coarse aggregate.

110-2.7 PLASTIC CONDUIT. Plastic conduit and fittings shall conform to the requirements of Fed. Spec. W-C-1094 and shall be one of the following, as specified in the proposal:

a. Type I - suitable for underground use either directly in the earth or encased in concrete.

b. Type II - suitable for either above ground or underground use.

CONSTRUCTION METHODS

110-3.1 GENERAL. The Contractor shall install underground ducts at the approximate locations indicated in the airport layout plans. The Engineer shall indicate specific locations as the work progresses. Ducts shall be of the size, material, and type indicated in the plans or specifications. Where no size is indicated in the plans or specifications, the ducts shall be not less than 3 inches (75 mm) inside diameter. All duct lines shall be laid so as to grade toward handholes, manholes and duct ends for drainage. Grades shall be at least 3 inches (75 mm) per 100 feet (30 m). On runs where it is not practicable to maintain the grade all one way, the duct lines shall be graded

from the center in both directions toward manholes, handholes, or duct ends. Pockets or traps where moisture may accumulate shall be avoided.

The Contractor shall mandrel each duct. An iron-shod mandrel, not more than 1/4-inch (6 mm) smaller than the bore of the duct shall be pushed through each duct by means of jointed conduit rods. The mandrel shall have a leather or rubber gasket slightly larger than the duct hole.

All ducts installed shall be provided with a No. 10 gauge galvanized iron or steel drag wire for pulling the permanent wiring. Sufficient length shall be left in manholes or handholes to bend the drag wire back to prevent it from slipping back into the duct. Where spare ducts are installed, as indicated on the plans, the open ends shall be plugged with removable tapered plugs, designed by the duct manufacturers, or with hardwood plugs conforming accurately to the shape of the duct and having the larger end of the plug at least 1/4-inch (6 mm) greater in diameter than the duct.

All ducts shall be securely fastened in place during construction and progress of the work and shall be plugged to prevent seepage of grout, water, or dirt. Any duct section having a defective joint shall not be installed.

All ducts, except steel conduit, installed under runways, taxiways, aprons, and other paved areas shall be encased in a concrete envelope.

Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored.

Trenches for ducts may be excavated manually or with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Blades of road patrols or graders shall not be used to excavate the trench. The Contractor shall ascertain the type of soil or rock to be excavated before bidding. All excavation shall be unclassified.

110-3.2 DUCTS ENCASED IN CONCRETE. Unless otherwise shown in the plans, concrete-encased ducts shall be installed so that the top of the concrete envelope is not less than 18 inches (45 cm) below the finished subgrade where installed under runways, taxiways, aprons, or other paved areas, and not less than 18 inches (45 cm) below finished grade where installed in unpaved areas. Ducts under paved areas shall extend at least 3 feet (90 cm) beyond the edges of the pavement or 3 feet (90 cm) beyond any underdrains which may be installed alongside the paved area. Trenches for concrete-encased ducts shall be opened the complete length before concrete is laid so that if any obstructions are encountered, proper provisions can be made to avoid them. All ducts for concrete encasements shall be placed on a layer of concrete not less than 3 inches (75 mm) thick prior to its initial set. Where two or more ducts are encased in concrete, the Contractor shall space them not less than 1-1/2 inches (37 mm) apart (measured from outside wall to outside wall) using spacers applicable to the type of duct. As the duct laying progresses, concrete not less than 3 inches (75 mm) thick shall be placed around the sides and top of the duct bank. End bells or couplings shall be installed flush with the concrete encasement where required.

When specified, the Contractor shall reinforce the bottom side and top of encasements with steel reinforcing mesh or fabric or other approved metal reinforcement. When directed, the Contractor shall supply additional supports where the ground is soft and boggy, where ducts cross under roadways, or where otherwise shown on the plans under such conditions, the complete duct structure shall be supported on reinforced concrete footings, piers, or piles located at approximately 5 foot (150 cm) intervals.

When clay or soapstone ducts are specified, they shall be installed with concrete encasement as described above. Clay conduit shall be of the single-bore type. Where the self-centering socket-joint type of single clay duct is used, conduit shall be built up, tier by tier, and separated only by sufficient mortar or fine aggregate concrete to bed the ducts evenly and fill all voids between ducts. Single ducts shall be jointed together and the joints grouted with Portland cement mortar. A suitable gasket (of rubber or other approved material) shall first be placed in the receptacle end of the duct, prior to the joining operation, in order to exclude all mortar from the duct.

Where the square bore butt joint type of clay duct, single or multicell, is used, sections shall be aligned with at least four steel dowel pins and joints wrapped with duct tape 6 inches (150 mm) wide and lapped 6 inches (150 mm). All joints in a bank of single-bore ducts shall be staggered, beginning evenly from the manhole or handhole, by means of short lengths 6, 8, 9, 12, and 15 inches (150, 200, 230, 300, 380 mm) long. Cement mortar shall be troweled around each and every joint. Voids in the duct bank, caused by the external shape of the corners of the conduit, shall also be filled with mortar. The joining and joints of soapstone duct shall be done in accordance with the manufacturer's recommendations.

110-3.3 DUCTS WITHOUT CONCRETE ENCASEMENT. Trenches for single-duct lines shall be not less than 6 inches (150 mm) nor more than 12 inches (300 mm) wide, and the trench for 2 or more ducts installed at the same level shall be proportionately wider. Trench bottoms for ducts without concrete encasement shall be made to conform accurately to grade so as to provide uniform support for the duct along its entire length.

A layer of fine earth material, at least 4 inches (100 mm) thick (loose measurement) shall be placed in the bottom of the trench as bedding for the duct. The bedding material shall consist of soft dirt, sand or other fine fill, and it shall contain no particles that would be retained on a ¼-inch (6 mm) sieve. The bedding material shall be tamped until firm.

Unless otherwise shown in plans, ducts for direct burial shall be installed so that the tops of all ducts are at least 18 inches (45 cm) below the finished grade.

When two or more ducts are installed in the same trench without concrete encasement, they shall be spaced not less than 2 inches (50 mm) apart (measured from outside wall to outside wall) in a horizontal direction and not less than 6 inches (150 mm) apart in a vertical direction.

Trenches shall be opened the complete length before duct is installed so that if any obstructions are encountered, proper provisions can be made to avoid them.

110-3.4 DUCT MARKERS. The location of the ends of all ducts shall be marked by a concrete slab marker 2 feet (60 cm) square and 4 inches (100 mm) thick extending approximately 1 inch (25 mm) above the surface. The markers shall be located above the ends of all ducts or duct banks, except where ducts terminate in a handhole, manhole, or building.

The Contractor shall impress the word "duct" on each marker slab. He shall also impress on the slab the number and size of ducts beneath the marker. The letters shall be 4 inches (100 mm) high and 3 inches (75 mm) wide with width of stroke ½-inch (12 mm) and ¼-inch (6 mm) deep or as large as the available space permits.

110-3.5 BACKFILLING. After concrete-encased ducts have been properly installed and the concrete has had time to set, the trench shall be backfilled in at least two layers with excavated material not larger than 4 inches (100 mm) in diameter and thoroughly tamped and compacted to at least the density of the surrounding undisturbed soil. If necessary to obtain the desired compaction, the backfill material shall be moistened or aerated as required.

Trenches shall not be excessively wet and shall not contain pools of water during backfilling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface: except that, when sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of in accordance with instructions issued by the Engineer.

For ducts without concrete envelope, 8 inches (200 mm) of sand, soft earth, or other fine fill (loose measurement) shall be placed around the ducts and carefully tamped around and over them with hand tampers. The remaining trench may be filled with regular run of excavated material and thoroughly tamped as specified above.

110-3.6 RESTORATION. Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the trenching, storing of dirt, cable laying, pad construction and other work shall be restored to its original condition. The restoration shall include any necessary topsoil, fertilizing, liming, seeding, sprigging, or mulching. All such work shall be performed in accordance with the FAA Standard Turfing Specifications. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance.

METHOD OF MEASUREMENT

110-4.1 Underground duct shall be measured by the linear feet (meter) of duct installed, measured in place, completed, and accepted. Separate measurement shall be made for the various types and sizes.

BASIS OF PAYMENT

110-5.1 Payment will be made at the contract unit price for each type and size of single-way or multi-way duct completed and accepted. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-110-5.1	Single-Way or Multi-Way Electrical Duct-per linear foot (meter)
----------------	---

MATERIAL REQUIREMENTS

Fed. Spec. W-C-571	Conduit and Fittings, Nonmetal, Rigid; (Asbestos-Cement or Fire-Clay Cement), (For Electrical Purposes)
--------------------	---

Fed. Spec. W-C-1094	Conduit and Fittings; Nonmetallic, Rigid, (Plastic)
---------------------	---

Underwriters Laboratories Standard 6	Rigid Metal Conduit
---	---------------------

Underwriters Laboratories Standard 514	Fittings for Conduit and Outlet Boxes
---	---------------------------------------

Underwriters Laboratories Standard 543	Impregnated-Fiber Electrical Conduit
---	--------------------------------------

Underwriters Laboratories Standard 1242	Intermediate Metal Conduit
--	----------------------------

ITEM L-119 INSTALLATION OF AIRPORT OBSTRUCTION LIGHTS

DESCRIPTION

119-1.1 This item shall consist of furnishing and installing obstruction lights in accordance with these specifications. Included in this item shall be the furnishing and installing of wood poles, steel or iron pipes, or other supports as required in the plans or specifications.

This item shall also include all wire and cable connections, the furnishing and installing of all necessary conduits and fittings, insulators, pole steps, pole cross arms, and the painting of poles and pipes. In addition, it includes the furnishing and installing of all lamps and, if required, the furnishing and installing of insulating transformers, the servicing and testing of the installation and all incidentals necessary to place the lights in operation as completed units to the satisfaction of the Engineer.

EQUIPMENT AND MATERIALS

119-2.1 GENERAL.

a. Airport lighting equipment and materials covered by Federal Aviation Administration (FAA) specifications shall be certified and listed under Advisory Circular (AC) 150/5345-53, Airport Lighting Equipment Certification Program.

b. All other equipment and materials covered by other reference specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the Engineer.

119-2.2 OBSTRUCTION LIGHTS. The obstruction lights shall conform to the requirements of AC 150/5345-43, Specification for Obstruction Lighting Equipment.

119-2.3 INSULATING TRANSFORMERS. Where required for series circuits, the insulating transformers shall conform to the requirements of AC 150/5345-47, Isolation Transformers for Airport Lighting Systems.

119-2.4 TRANSFORMER HOUSING. Transformer housings, if specified, shall conform to AC 150/5345-42, Specification for Airport Light Base and Transformer Housings, Junction Boxes, and Accessories.

119-2.5 CONDUIT. Steel conduit and fittings shall be in accordance with Underwriters Laboratories Standard 6, 514, and 1242.

119-2.6 WIRES. Wires in conduit rated up to 5,000 volts shall conform to AC 150/5345 7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits, for rubber insulated neoprene covered wire, or Fed. Spec. J-C-30, Type RHW, for rubber insulated fibrous covered wire. For ratings up to 600 volts, thermoplastic wire conforming to Fed. Spec. J-C-30, Types TW, THW, and THWN, shall be used. The wires shall be of the type, size, number of conductors, and voltage shown in the plans or in the proposal. Overhead line wire from pole to pole, where specified, shall conform to ANSI/ICEA S-70-547-1992.

119-2.7 MISCELLANEOUS. Paint, poles, pole steps, insulators, and all other miscellaneous materials necessary for the completion of this item shall be new and first-grade commercial products. These products shall be as specified in the plans or specifications.

CONSTRUCTION METHODS

119-3.1 PLACING THE OBSTRUCTION LIGHTS. The Contractor shall furnish and install single-or double-obstruction lights as specified in the proposal and shown in the plans. The obstruction lights shall be mounted on poles, buildings, or towers approximately at the location shown in the plans. The exact location shall be as directed by the Engineer.

119-3.2 INSTALLATION ON POLES. Where obstruction lights are to be mounted on poles, each obstruction light shall be installed with its hub at least as high as the top of the pole. All wiring shall be run in not less than 1-inch (25 mm) galvanized rigid steel conduit. If specified, pole steps shall be furnished and installed, the lowest step being 5 feet (150 cm) above ground level. Steps shall be installed alternately on diametrically opposite sides of the pole to give a rise of 18 inches (45 cm) for each step. Conduit shall be fastened to the pole with galvanized steel pipe straps and shall be secured by galvanized lag screws. Poles shall be painted as shown in the plans and specifications.

When obstruction lights are installed on existing telephone or power poles, a large fiber insulating sleeve of adequate diameter and not less than 4-feet (120 cm) long, shall be installed to extend 6 inches (150 mm) above the conductors on the upper cross arm. In addition, the sleeve shall be at least 18 inches (45 cm) below the conductors on the lower crossarm. The details of this installation shall be in accordance with the plans.

119-3.3 INSTALLATION ON BEACON TOWER. Where obstruction lights are installed on a beacon tower, two obstruction lights shall be mounted on top of the beacon tower using 1-inch (25 mm) conduit. The conduit shall screw directly into the obstruction light fixtures and shall support them at a height of not less than 4 inches (100 mm) above the top of the rotating beacon. If obstruction lights are specified at lower levels, the Contractor shall install not less than ½-inch (12 mm) galvanized rigid steel conduit with standard conduit fittings for mounting the fixtures. The fixtures shall be mounted in an upright position in all cases. The conduit shall be fastened to the tower members with “wraplock” straps, clamps, or approved fasteners spaced approximately 5 feet (150 cm) apart. Three coats of aviation-orange paint shall be applied (one prime, one body, and one finish coat) to all exposed material installed.

119 3.4 INSTALLATION ON BUILDINGS, TOWERS, SMOKESTACKS, ETC. Where obstruction lights are to be installed on buildings or similar structures, the installation shall be made in accordance with details shown in the plans. The hub of the obstruction light shall be not less than 1 foot (30 cm) above the highest point of the obstruction except in the case of smokestacks where the uppermost units shall be mounted not less than 5 feet (150 cm), nor more than 10 feet (3 m) below the top of the stack. Conduit supporting the obstruction light units shall be fastened to wooden structures with galvanized steel pipe straps and shall be secured by 1-½ inch (37 mm) No. 10 galvanized wood screws. Conduit shall be fastened to masonry structures by the use of expansion shields, screw anchors, or toggle bolts using No. 10, or larger, galvanized wood or machine screws. Conduit fastened to structural steel shall have the straps held with not less than No. 10 roundhead machine screws in drilled and tapped holes. Fastenings shall be approximately 5 feet (150 cm) apart. Three coats of aviation-orange paint shall be applied (one prime, one body, and one finish coat) to all exposed material installed.

119-3.5 SERIES INSULATING TRANSFORMERS. The L-810 series obstruction light does not include a film cutout; therefore, an insulating transformer is required with each series lamp. Double series units of this type require two series insulating transformers. The transformer shall be housed in a base or buried directly in the earth in accordance with the details shown in the plans.

119-3.6 WIRING. The Contractor shall furnish all necessary labor and materials and shall make complete electrical connections from the underground cable or other source of power in accordance with the wiring diagram furnished with the project plans. If underground cable is required for the power feed and if duct is required under paved areas, the cable and duct shall be installed in accordance with (and paid for by) linear foot measurement as described in Item L-108, Installation of Underground Cable for Airports, and Item L-110, Installation of Airport Underground Electrical Duct.

119-3.7 LAMPS. The Contractor shall furnish and install in each unit one or two lamps, as required, conforming to the following requirements:

- a. Series lamp-6.6 ampere, 1020-lumen, a-21 clear bulb, medium prefocus base.

- b. Multiple lamp-100, 107, or 116 watts; 115, 120, or 125 volts; a-21 clear bulb, medium screw base.

119-3.8 TESTS. The installation shall be fully tested by continuous operation for not less than 1/2 hour as a completed unit prior to acceptance. These tests shall include the functioning of each control not less than 10 times.

METHOD OF MEASUREMENT

119-4.1 The quantity of lights to be paid for under this item shall be the number of single- or double-type obstruction lights installed and accepted as completed units, in place, ready for operation.

BASIS OF PAYMENT

119-5.1 Payment will be made at the contract unit price for each completed obstruction light installed, in place by the Contractor, and accepted by the Engineer. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-119-5.1	Airport Obstruction Light, in Place-per each
----------------	--

MATERIAL REQUIREMENTS

AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-42	Specification for Airport Light Base and Transformer Housing, Junction Boxes, and Accessories
AC 150/5345-43	Specification for Obstruction Lighting Equipment
AC 150/5345-47	Isolation Transformers for Airport Lighting Systems
ANSI/ICEA S-70-547-1992	Weather-Resistant Polyolefin-Covered Wire and Cable
Fed. Spec. J-C-30	Cable and Wire, Electrical (Power, Fixed Installation)